The International Space Station

The International Space Station draws upon the resources and the scientific and technological expertise of 15 cooperating nations, including the United States, Canada, Japan, Russia and 11 member nations of the European Space Agency. The International Space Station Program has three distinct phases, each building on the prior one and representing new milestones and capabilities. Phase 1, now under way, involves stays by U.S. astronauts aboard the Russian Mir Space Station and dockings between the Space Shuttle and the Mir. Phase 1 builds joint space experience and begins scientific research between the United States and Russian partners using existing facilities and resources.

Phase 2 of the International Space Station Program, construction in orbit, begins in June 1998 with the launch of the Functional Cargo Block (FGB) from Russia on a Russian Proton rocket. The 21-ton FGB has been built in Russia but purchased by the United States. It will provide attitude control and propulsion during the early assembly operations plus solar power and berthing ports for additional modules. In July 1998, the U.S.-built Node 1 will be delivered by the Space Shuttle and attached to the FGB. Next, the first wholly Russian contribution, a component called the Service Module that will provide the first living quarters and life support systems, will be launched from Russia in December 1998. After two more Space Shuttle assembly flights, the first people, a three-person crew, will be launched aboard a Russian Soyuz capsule to spend more than four months on the station. From that point on, the station will be permanently inhabited. Phase 2 of the station's assembly will be completed in August 1999, at which point the station will be ready for scientific research work to begin in a U.S. laboratory module. Phase 3 of assembly will see the International Space Station progress gradually to its ultimate status with a crew of up to seven members; laboratory modules supplied by Russia, Europe, Japan and the United States; and a robotic arm supplied by Canada. The complete assembly sequence for the station calls for space flights launched by at least three different types of vehicles – the Space Shuttle, the Russian Proton rocket and the Russian Soyuz rocket.

The pressurized living and working space aboard the completed station will be roughly equivalent to the passenger cabin volume of two 747 jetliners. The atmospheric pressure in the station will be 14.7 pounds per square inch, the same as on Earth's surface. There will be six laboratories. The U.S. will provide one lab and a habitation module that will replace and supplement the Service Module's early crew living quarters. There will be two Russian research modules; oneJapanese laboratory called the Japanese Experiment Module (JEM); and one European Space Agency laboratory called the Columbus Orbital Facility (COF). The U.S., ESA and Japanese laboratories together will provide 33 International Standard Payload Racks for research equipment and experiments. Additional research room will be available in the Russian modules, connecting Nodes and a Centrifuge Accomodation Module (CAM). The JEM also has an exterior "back porch" with 10 spaces for mounting experiments that need to be exposed to space. The experiments will be set outside using a small robotic arm on the JEM.

The central girder connecting the modules and the main solar power arrays will be built by the U.S. and is called the integrated truss structure. The Canadian-built Remote Manipulator System, a 55-foot robot arm and a grappling mechanism called the Special Purpose Dexterous Manipulator (SPDM), will move along the truss on a mobile base transporter to perform assembly and maintenance work. The four solar arrays will rotate on the truss to maximize their exposure to the sun. An emergency crew return vehicle, initially a Russian Soyuz spacecraft and later a higher-capacity vehicle currently under development by NASA called the X-38, will always be docked with the station while it is inhabited. In addition, a number of vehicles, both with people aboard and without, will be constantly visiting the Space Station including the Space Shuttle (U.S., piloted), Soyuz (Russia, unpiloted), Progress resupply spacecraft (Russian, unpiloted), H-II Transfer Vehicle (HTV, Japanese, unpiloted), and Autonomous Transfer Vehicle (ATV, Europe, unpiloted).

International Space Station Assembly Sequence

Date	Flight	Launch	Element	Highlights
June 1998	1 A/R	Russian	Functional Cargo Block	Provides propulsive control capability, fuel storage, and rendezvous and docking capability with the Service Module.
July 1998	2A	US	Node 1, Pressurized Mating Adapters	Provides interfaces between US and Russian elements.
Dec 1998	1R	Russian	Service Module	Provides environmental control and life support system functions, crew quarters.
Dec 1998	2A.1	US	Logistics	Adds margin and flexibility to assembly.
Jan 1999	3A	US	Integrated Truss Structure, Pressurized Mating Adapter-3, Ku-Band and Control Moment Gyroscopes	Truss allows the temporary installation of the Photovoltaic Module for early US-based power. Ku-band communication system supports early science capability. Pressurized Mating Adapter provides shuttle docking port and Control Moment Gyros will provide non-propulsive attitude control.
Jan 1999	2R	Russian	Soyuz	Initial habitation with three-person crew, provides assured crew return capability.
March 1999	4A	US	Integrated Truss Structure, Photovoltaic Module	Establishes initial Photovoltaic Module based power capability
May 1999	5A	US	US Lab	Provides module for initial research facilities.
June 1999	6A	US	Ultra-High Frequency Antenna and Space Station Remote Manipulator System	Antenna provides space-to-space communications for space walking, Space Station Remote Manipulator System robotic arm required to perform station remote assembly operations on later flights.
Aug 1999	7A	US	Joint Airlock and High Pressure Gas Assembly	Provides station-based U.S. and Russian spacewalking capability.
Oct 1999	7A.1	US	Outfittting, logistics	U.S. outfitting prior to utilization flights, adds margin and flexibility to assembly sequence
Dec 1999	4R	Russian	Docking Compartment 1	Provides egress, ingress for Russian-based spacewalks and a Soyuz docking port.
Jan 2000	UF-1	US	Utilization Flight-1	Payload resupply and/or changeout.
Feb 2000	8A	US	Integrated Truss Structure, Mobile Transporter	Integrated Truss Structure provides attachment and umbilicals between pressurized elements.
Mar 2000	UF-2	US	Utilization Flight-2	Payload resupply and/or changeout.
June 2000	9A	US	Integrated Truss, Central Thermal Control System	Delivers the starboard Central Thermal Control System.
July 2000	9A.1	US	Russian Solar Power Platform, European Robotic Arm	Delivery of the Russian power/control mast with four solar arrays providing additonal power to Russian segments and delivers the European Robotic Arm.
Oct 2000	11A	US	Integrated Truss	Delivers the port Thermal Control System
Nov 2000	12A	US	Integrated Truss, Photovoltaic Module	Provides additional Photovoltaic Module-based power.

<u>Note</u>*: Dates for flights after UF-5 under evaluation until Fall '97.*

Date	Flight	Launch	Element	Highlights
Dec 2000	5R	Russian	Docking Compartment 2	Replace discarded Docking Compartment 1.
Mar 2001	13A	US	Integrated Truss, Photovoltaic Module	Provides additional Photovoltaic Module-based power.
Apr 2001	10A	US	Node 2, Nitrogen Tank Assembly	Node 2 provides attach locations for future modules and establishes primary shuttle docking location.
May 2001	1J/A	US	Integrated Truss, Japanese racks	Delivers Japanese experiment racks for upcoming lab module.
Aug 2001	1J	US	Japanese Experiment Module	Japanese Experiment Module laboratory is delivered and activated.
Sept 2001	UF-3	US	Utilization Flight 3	Payload resupply and/or changeout.
Jan 2002	UF-4	US	Alpha Magnetic Spectrometer	Delivers Alpha Magnetic Spectrometer to research cosmic ray propagation.
Feb 2002	2J/A	US	JEM Exposed Facility	Delivers "back porch" exposed experiment facility for Japanese Experiment Module.
Feb 2002	9R.1	Russian	Docking and Stowage Module-1	Provides addtional on-orbit stowage and a Soyuz docking location.
May 2002	9R.2	Russian	Docking and Stowage Module-2	Provides additional on-orbit stowage and a Soyuz docking location.
May 2002	14A	US	Cupola, Port Rails, 4 Solar Power Platform arrays	Cupola provides direct viewing capability for some robotics operations and payloads; arrays increase power for Russian segment.
June 2002	UF-5	US	Utilization Flight-5	Payload resupply and/or changeout.
TBD	2E	US	Lab Racks, JEM Small Fine Arm	Delivers more lab racks; Small Fine Arm will service payloads on JEM "back porch."
TBD	8R	Russian	Research Module-1	Provides Russian research facilities.
TBD	16A	US	Habitation Module	US Habitation Module delivered, activated.
TBD	10R	Russian	Research Module-2	Provides Russian research facilities.
TBD	17A	US	Habitation Module outfitting	Provides basic habitation facilities to outfit module for crewmembers.
TBD	11R	Russian	Life Support Module-1	Life Support Module provides oxygen generation capability and other functions.
TBD	12R	Russian	LIfe Support Module-2	Second Life Support Module supplements oxygen generation, other functions.
TBD	18A	US	Crew Return Vehicle	Crew Return Vehicle attached to station provides "lifeboat" capability for up to 7 crew.

TBD	19A	US	Habitation Module Outfitting	Completes outfitting of Habitation Module.
TBD	15A	US	Photovoltaic Module	Fourth US truss-based photovoltaic module completes the major power elements.
TBD	UF-6	US	Utilization Flight-6	Payload resupply and/or changeout.
TBD	UF-7	US	Centrifuge	Delivers Centrifuge Accomodation Module.
TBD	1E	US	Columbus Orbital Facility	Delivers European Space Agency research facility.